IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

17/Declar.
Theresa
1-25-01

In re aplication of

ANTHONY J. KONECNI ET AL.

Serial No. 08/988,686 (TI-22166)

Filed December 11, 1997

For: METHOD AND SYSTEM FOR SELECTIVELY COUPLING A CONDUCTIVE MATERIAL TO A SURFACE OF A SEMICONDUCTOR DEVICE

Art Unit 2823

Examiner K. Eaton

Commissioner for Patents
Washington, D. C. 20231

Sir:

DECLARATION OF JAY M. CANTOR

Jay M. Cantor declares as follows:

1. THAT he is a registered patent attorney, Reg. No. 19906, and the attorney presently responsible for prosecution of the subject application;

2. THAT he has reviewed the file of the subject application and, on information and belief, the attached invention disclosure is a true copy of the invention disclosure mentioned in the Declarations of Christopher W. Kennerly and Barton E. Showalter previously filed in the subject application with dates redacted.

3. THAT all dates set forth in the invention disclosure predate September 17, 2996.

I declare under the penalty of perjury that the above facts are true and correct.

1-22-01
Date

Jay M. Cantor

2020
CHH

DOCKET NO. TI 22166

* ********************************** *
* IF ELECTRONICALLY TRANSMITTED, *
* PROCESSING OF YOUR DISCLOSURE *
* CANNOT BE COMPLETED WITHOUT *
* A FOLLOW-UP COPY SIGNED AND *
* DATED BY ALL INVENTORS AND *
* AT LEAST ONE WITNESS. *
****

1. **Please suggest a descriptive title for your invention:**
Plasma Pretreatment for Selective CVD Al Deposition for Inter-metal Connections

2. **What is the problem solved by your invention?**
Elimination of the oxide interface between the selective CVD Al film and the underlying material.

3. **What is your solution to the problem?**
The use of a chemically aided via/contact cleaning process.

4. **When was your solution first conceptually or mentally complete?** **Date:** ____/____/____.

5. **What is the first tangible evidence of such completion?**
Date: ____/____/____

6. **What is different about your solution, compared with other solutions to the same problem?**
Other selective CVD Al fill techniques do not utilize a low power chemical cleaning of the via.

7. **What are the advantages of your solution?**
Smaller footprint of cluster tool, fewer chambers, lower process cost.

8. **What TI products, processes, projects or operations currently implement your invention?**
None.

9. **What is the date of the first implementation?** ___/___/____.

10. **What record exists to prove this date?**

11. **Is there any future implementation planned? (Y/N)**
Possible in .35um and below products

12. **Has the invention been published or disclosed to anyone outside of TI? (Y/N)** __N__ **When?** ______ **If planned - When?** ______ **(Catalog, advertising, data book, application note, conference paper, magazine article, TI TJ, proposal document.) Was there a nondisclosure agreement (NDA)? (Y/N)** ______.

13. Has a TI product incorporating the invention been publicly introduced, quoted, sampled or shipped? (Y/N) N
When? _____ If planned--when? _____.

14. Was the invention conceived or first implemented in the performance of a government contract or subcontract?
(Y/N) N Contract #: _____

THE INVENTION DESCRIBED BY THIS DISCLOSURE IS SUBMITTED PURSUANT TO MY EMPLOYMENT AGREEMENT WITH TEXAS INSTRUMENTS INCORPORATED OR A TI SUBSIDIARY (SPECIFY):

IS THIS A CONFIRMATION OF A PRIOR DISCLOSURE TO THE PATENT DEPARTMENT? (Y/N) N

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This invention disclosure with any attachments was read and understood by me on _____

TI PATENT DEPT

Charles Li
Witness Date

This invention disclosure with any attachments was read and understood by me on _____

Witness

Date

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TI PATENT DEPT

Patent: Plasma Pretreatment for Selective CVD Al Deposition for Inter-metal Connections
Inventors: Anthony Konecni, Girish Dixit

Background

A common process to fill vias and contacts in multilevel metal structures is the use of chemical vapor deposition of Tungsten plugs. Due to the high resistivity of Tungsten, chemical vapor deposition of Aluminum is being investigated as a replacement for Tungsten. Chemical vapor deposition of Aluminum can be achieved via a blanket deposition of the Aluminum film over blanket deposition of a liner material or selective Aluminum deposition in the via or contact only.

Another widely used process known as sputter deposition achieves microscopic cleaning of surfaces by physical bombardment of inert gas atoms/ions. While this process aids in providing excellent electrical contact between adjacent conductive layers, topologically sharp features are also subject to preferential bombardment leading to unwanted shape changes of these features. Moreover, for high aspect ratio features, high ion energies are necessary in order to achieve sufficient bombardment at the bottom of the feature. A chemically aided cleaning process is therefore needed for achieving good contact characteristics between adjacent interconnect layers.

This invention presents a process scheme for selective CVD Aluminum that uses a low power - low ion energy plasma for achieving good contact resistances between the two levels of interconnects.

Outline of the invention

Following the process of via pattern and etch, the invention encompasses the use of following steps.

1. A low power plasma treatment of the via structure. Gases such as Nitrogen, Hydrogen and Argon (or combinations of these) may be used in this step. Nitrogen/Argon, being heavier ions would aid in physical bombardment of the substrate surfaces and hydrogen would provide a chemical nature to the process by reducing the thin oxide layers present on the metallic surfaces of the via. In addition, Nitrogen would also lead to nitridation of the metallic surface (TiN-O or Al-alloy). Metallic nitrides (stiochiometric/non-stoichiometric) are known to be conductive.
2. Sequential or in-situ deposition of aluminum via selective chemical vapor deposition.
3. Sequential or ex-situ physical vapor deposition of Al-Cu (0-2.0%Cu).

Advantages of New Process Sequence

The proposed process sequence will enable the elimination of the use of a high power preclean treatment of the via/contact and the use of a complicated chemical based pretreatment of the via/contact. This would have significant impact on reducing the complexity of the metallization cluster tool and also contribute to reducing the overall cost of the plug/interconnect process.